

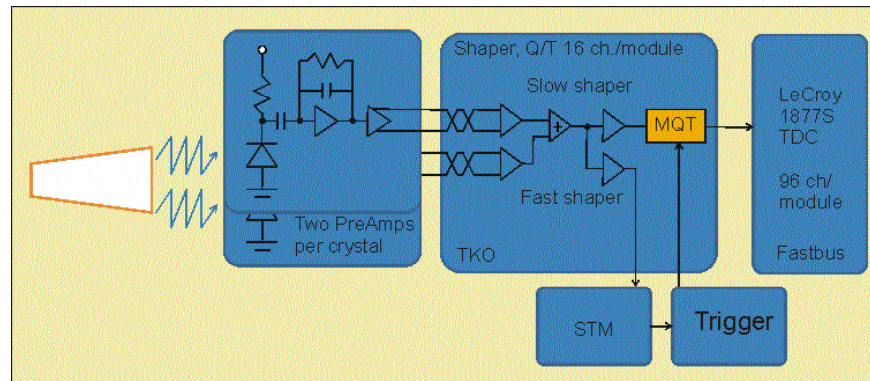
# Next version of new shaper- digitizer module

Vladimir Zhulanov, Yury Usov

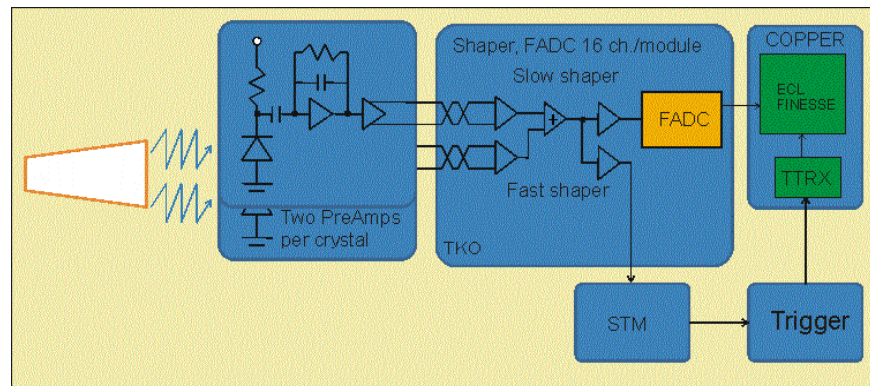
BINP, Russia

2009.03.19

# Update of barrel electronics

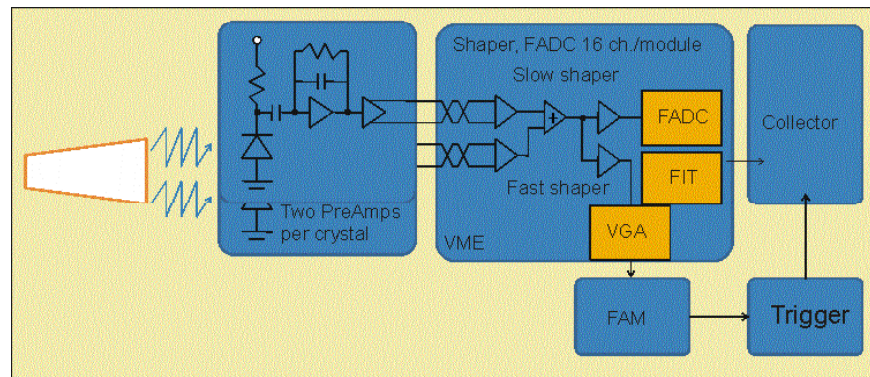


Current electronics  
Belle  
Q – T – D



Shaper-ADC

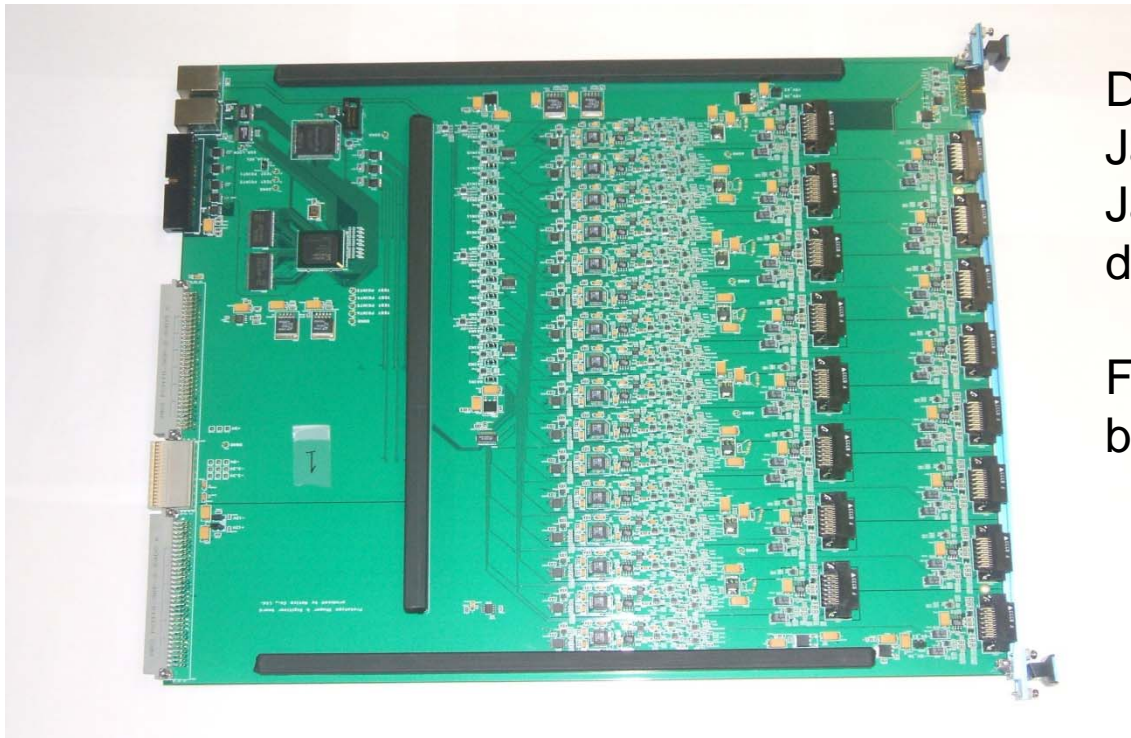
SuperBelle  
FADC, pipeline



Shaper-DSP

SuperBelle  
FADC, pipeline, DSP on shaper board

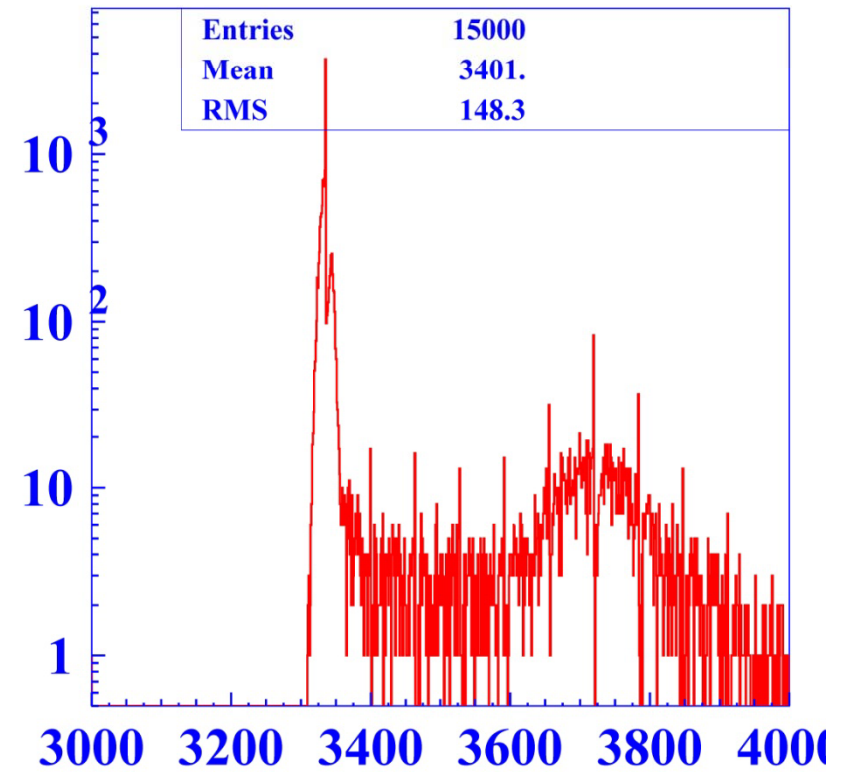
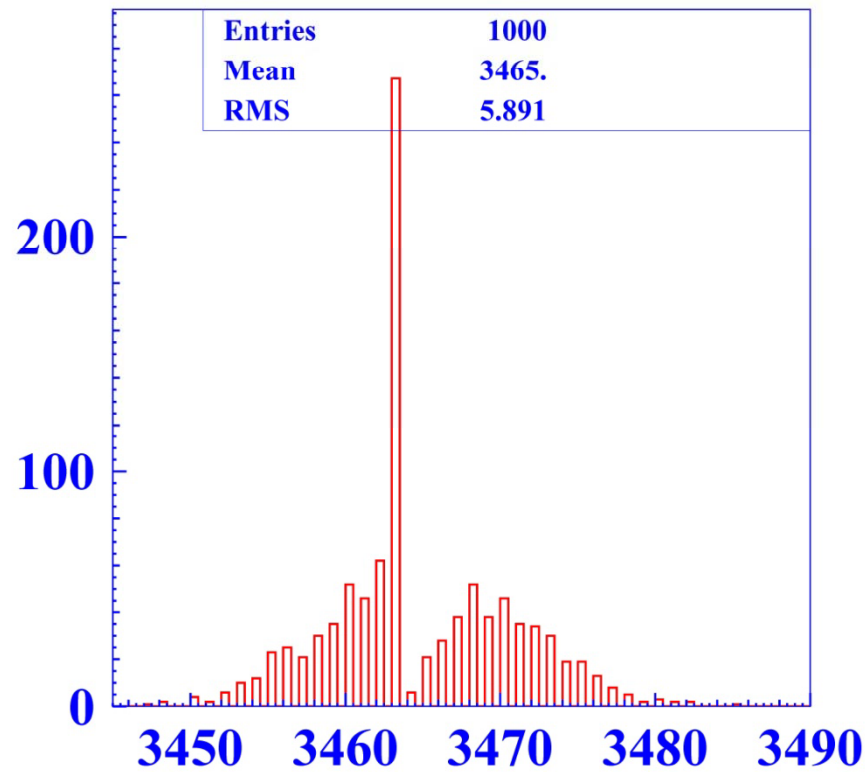
# Shaper-DSP



Dec.2008 – manufactured  
Jan.2009 – shipped to KEK  
Jan.2009...now – firmware  
development, tests

Few modifications have  
been made

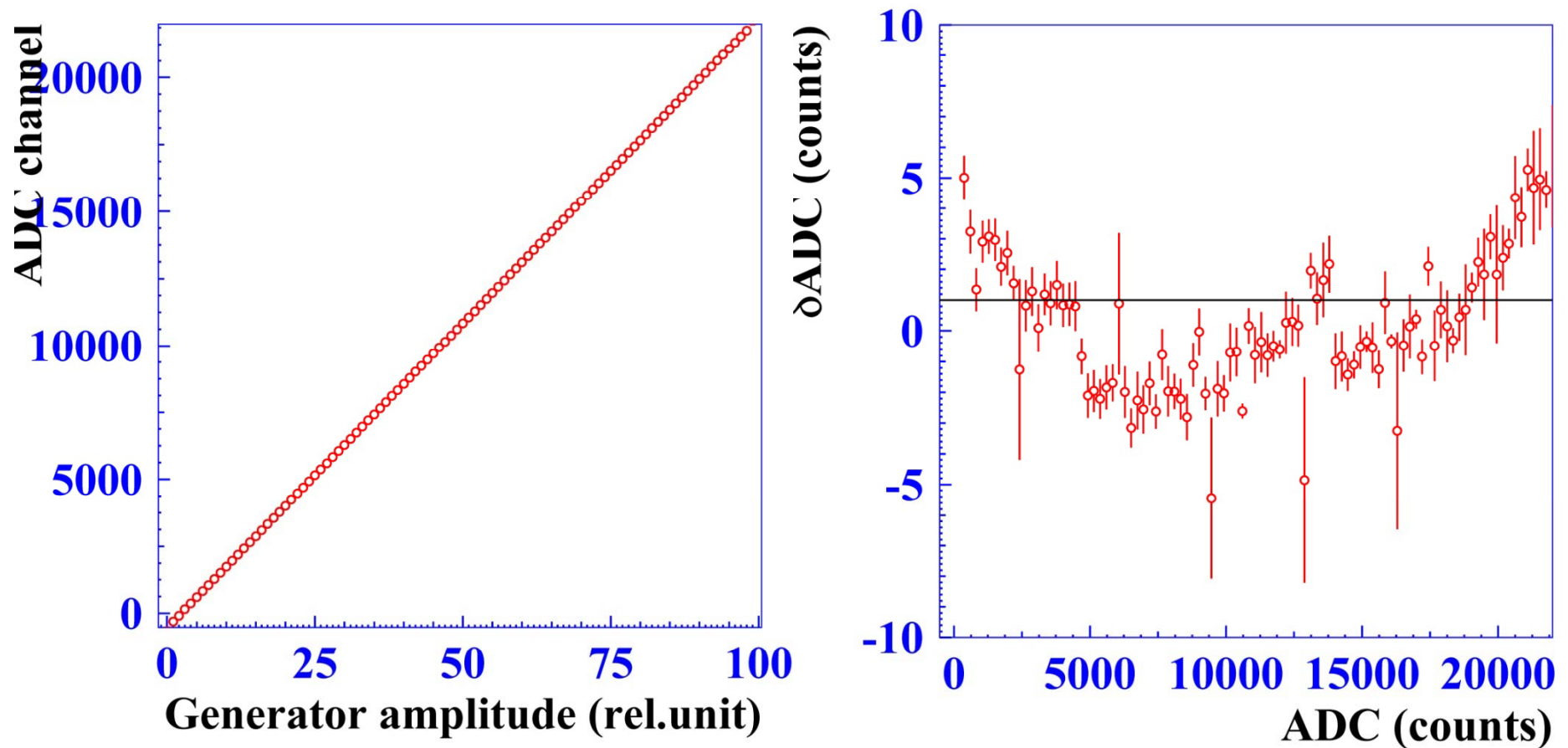
# Noise



Some ADC or PCB layout problem



# Dynamic range



Good linearity

It's needed to use custom Voltages in VME bus:  
5  $\rightarrow$  7.5, 12  $\rightarrow$  15

# Status (1)

Things to be done with this board:

1. ADC replacement.
2. coherent noise
3. Small firmware update: S/N, temperatures read out and a few other things

## Status (2)

We need the new readout system with optical links to make the design ECL data collector and test waveform analysis on the Shaper-DSP module!

The new version of the Shaper-DSP module will be designed by April 2009:

1. ADC redesign
2. The capacitors issue: Tantalum → ceramic (???)
3. Supply
4. Tail compensation for FAM

Thank you



# Backup

# Waveform fitting

$$\chi^2(A, p, t_0) = \sum_{i,j} (y_i - Af(t_i - t_0) - p) S_{ij}^{-1} (y_j - Af(t_j - t_0) - p) \rightarrow \min$$

$A, p, t_0$  – fitting parameters : Amplitude, pedestal and time of the signal

$S_{ij} = \overline{(y_i - \bar{y})(y_j - \bar{y})}$  – covariance matrix,

$f(t)$  – counter response,

$y_i$  – sampled values.

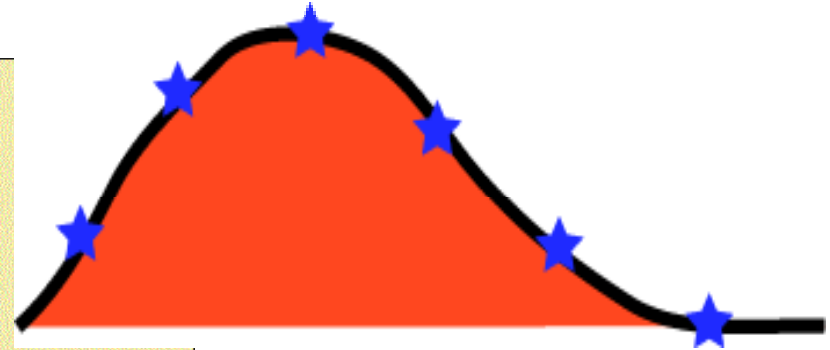
$$Af(t_i - t_1 - \Delta t) = Af(t_i - t_1) - A\Delta t f'(t_i - t_1) = Af(t_i - t_1) + Bf'(t_i - t_1)$$

where  $t_1$  – initial time (trigger time at first iteration),

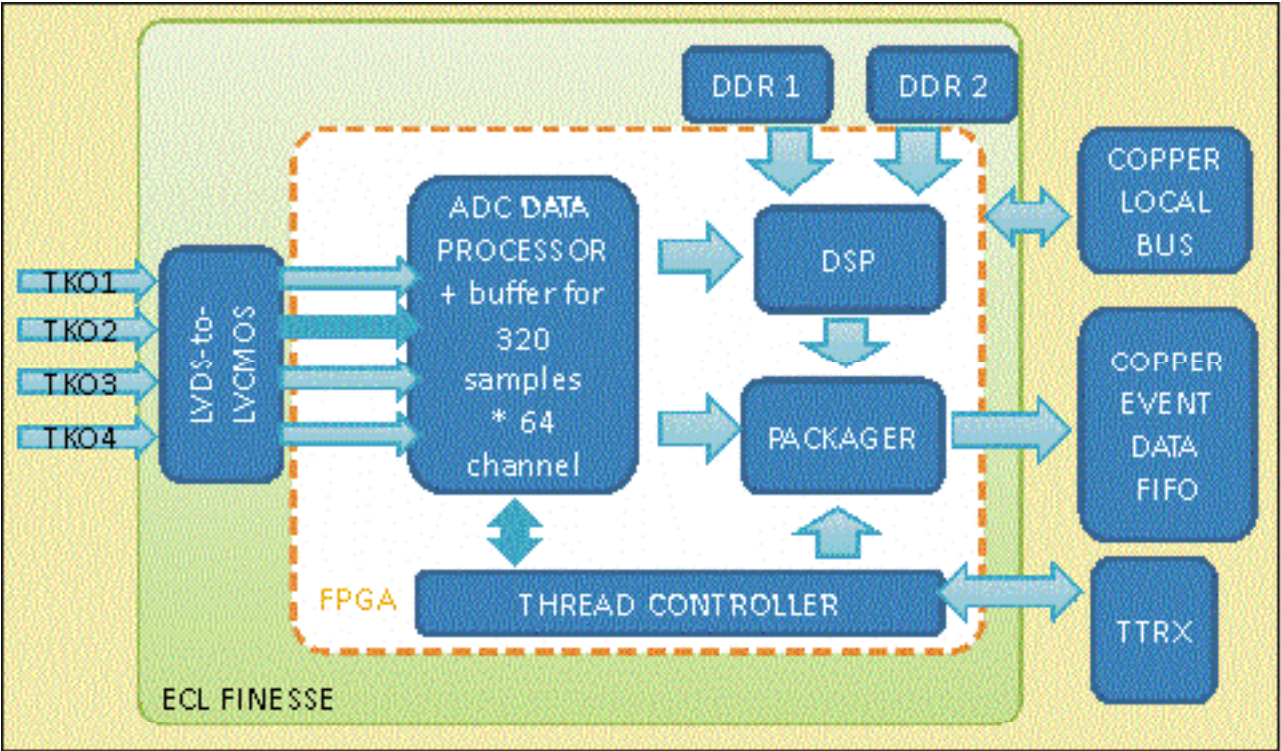
$$t_0 = t_1 + \Delta t, B = -A\Delta t.$$

$$\begin{aligned} \sum_{i,j} f_{i,t_1} S_{ij}^{-1} (y_j - Af_{j,t_1} - Bf'_{j,t_1} - p) &= 0 & a_{t_1}^{11} A + a_{t_1}^{12} B + a_{t_1}^{13} p &= \sum_i b_{t_1}^1 y_i & A &= \sum_i \alpha_{i,t_1} y_i \\ \sum_{i,j} f'_{i,t_1} S_{ij}^{-1} (y_j - Af_{j,t_1} - Bf'_{j,t_1} - p) &= 0 \Rightarrow a_{t_1}^{21} A + a_{t_1}^{22} B + a_{t_1}^{23} p &= \sum_i b_{t_1}^2 y_i &\Rightarrow B = \sum_i \beta_{i,t_1} y_i; t_0 = t_1 - B / A \\ \sum_{i,j} S_{ij}^{-1} (y_j - Af_{j,t_1} - Bf'_{j,t_1} - p) &= 0 & a_{t_1}^{31} A + a_{t_1}^{32} B + a_{t_1}^{33} p &= \sum_i b_{t_1}^3 y_i & p &= \sum_i \gamma_{i,t_1} y_i \end{aligned}$$

where  $f_{i,t_1} = f(t_i - t_1)$ ,  $f'_{i,t_1} = f'(t_i - t_1)$ , and  $\alpha_{i,t_1}, \beta_{i,t_1}, \gamma_{i,t_1}$  – precomputed coefficients



# ECL FINESSE





# Shaper-ADC and ECL FINESSE

